

CHANGING SCENARIO OF LAND USE AND LAND COVER IN LEH DISTRICT

ANURADHA SHARMA & DEACHEN CHOROL

Department of Geography, University of Jammu, Jammu and Kashmir, India

ABSTRACT

This paper has examined the dynamics of Land use and land cover during the period (2005-06 and 2011-12) of six years in Leh district of Jammu and Kashmir state. Leh is one of the districts of Ladakh region and though it has remained inaccessible to the outer world due to its unique and difficult terrain and inhospitable climate, the district has witnessed rapid rate of transformation in its pattern of Land use. The study reveals that there is a significant increase in the area under Built up and contrary to that the area under Snow and Glacier is on the decline.

KEYWORDS: Land Use, Land Cover, LEH, PGA- Percentage to the Total Geographical Area, LULCC- Land use and Land Cover Change & LULC- Land use and Land Cover

Received: Mar 15, 2019; **Accepted:** Apr 05, 2019; **Published:** Apr 19, 2019; **Paper Id.:** IJHRMRJUN20192

INTRODUCTION

The terms land use and land cover is time and again used interchangeably, however, each one has its own different meaning. Land cover refers to the general cover of the Earth surface, as represented by natural elements like vegetation, water, exposed earth, solid surface and other physical features of the land. Whereas; land use refers to the activity, economic function, proposed use, and management strategy to be found on the land cover by humans who basically are the land managers. Anthropogenic activities have contributed significantly to the alteration of the structure and functioning of the ecosystem (Vitonset et al., 1997). Ever since the beginning of human civilization on the planet Earth; change in the way of use of land has always been a phenomenon. Through various studies in both the western and the eastern worlds, there is a notable trend of conversion of cropland for urbanization purposes (Best & Champion, 1970; Dadhich & Hanaoka, 2011). The most spatially and economically imperative human use of land worldwide includes cultivation of different kinds, construction, reserves, protected lands and timber extraction (Turner et al, 1994). Increase in urban areas and a decrease in the agriculture has been one of the characteristic features of land use internationally (Blewett & Lane, 1988; Drozd & Johnson, 2004; Bhupal, 2012; Kumar, 2012; Hui & Bao, 2013). Though humans have been modifying land to obtain food and other essentials for thousands of years, current rates, extents and intensities of LULCC are far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales. Changes in the Land use and land cover has always in a way affected ecosystem services, biodiversity, food security, soil, human health, urbanization, and global climate (Falcucci et al., 2007; Sala et al., 2000; Khan et al., 2017; Xiaojuan et al., 2018).

Study Area

The district of Leh lies between the latitude of 32 to 36 degree north and between the longitude of 75 to 80 degree east and the altitude ranges from 2300 meters to 5000 meters above sea level. District Leh with an area of 45100 Sq Kms makes it 2nd largest district in the country after Kutch (Gujarat) with an area 45652 Sq Kms in terms of area. The district is bounded by Pakistan occupied Kashmir in the west and China in the north and eastern part and Lahul Spiti of Himachal Pradesh in the southeast. Topographically, the whole of the district is mountainous with three parallel ranges of the Himalayas, the Zaskar, the Ladakh, and the Karakoram. Between these ranges, the Shayok, Indus, and Zaskar rivers flow and the majority of the population lives in valleys of these rivers.

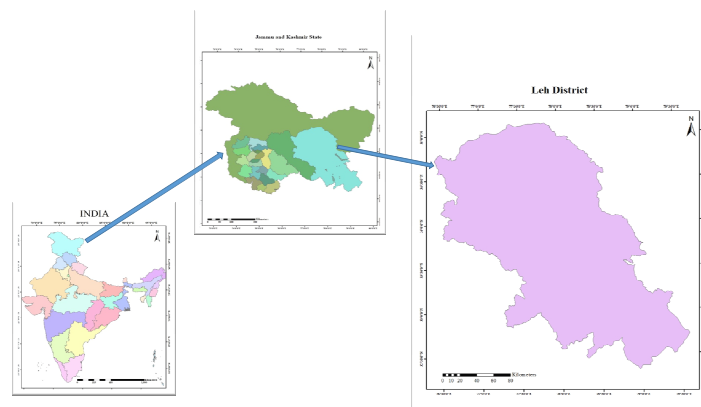


Figure 1: Location Map of the Study Area

OBJECTIVES OF THE STUDY

Leh is one of the two districts of the Ladakh region. With unique geographical features it has remained inaccessible and isolated for quite a long period. The labor work and tourism-related business are growing means of livelihood in recent times to which the people are attracted and a general decline in the population of domestic animals (sheep, goats, horses, donkeys and even yaks) and it is also been seen as one of the reasons for the outmigration of the Changpas (Ladakhi nomads). Nevertheless, agriculture still remains the basic economic activity of the rural people of Leh, though priorities are changing with increasing emphasis on vegetable cultivation, a collection of the Sea buckthorn, tree plantation, growing of Alfa-Alfa as a fodder crop and dairy development. Therefore, the objective of this study is;

- To study the share of area under different Land use and land cover categories during each period (2005-06 to 2011-12)
- To analyze the temporal pattern of changes in the Land use and land cover during the period of six years (2005-06 to 2011-12).

DATA SOURCES AND METHODOLOGY

Materials

The study is based on the secondary data acquired from Bhuvan Thematic Services which facilitates Technical documents; Statistics and Map under the National Resources Census- Land use and Land cover Database, NRSC. The Statistics is again acquired from the Web services (WMS/WMTS) URL's which can be accessed via: WMTS: <http://bhuvan5.nrsc.gov.in/bhuvan/gwc/services/wmts/> and WMS: <http://nhuvan5.nrsc.gov.in/bhuvan/wms>

Methods

(Computed by the authors)

- Absolute Change is calculated as;

Value of LULC in a later year– Value of LULC in the base year

- Percentage to the total geographical area is calculated as;

$$PGA = \frac{\text{Area of each LULC}}{\text{Total geographical area}} \times 100$$

- Relative Change is calculated as;

$$\text{Relative Change} = \frac{\text{Absolute Change}}{\text{Value of LULC in the base year}} \times 100$$

- The graphical representation of the results is also made for easy understanding.

RESULTS AND DISCUSSIONS

Land use of an area is a primary and significant pointer of the extent and measure to which land resources are being tailored by the humans. The information on the land use/ land cover in the present study broadly includes 7 categories of land cover namely; Built up, Agriculture, Barren/ wasteland, Wetlands/ water bodies, Snow & glaciers, Forest and lastly Grass/grazing. The land cover categories are further divided into land use classes separately. The unit for area is Square Kilometers (Km²).

Table 1: Land Cover Classification (2005-06 and 2011-12)

S. No	Classes	2005-06	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Built up	4.74	0.01	11.88	0.03	7.14	150.63
2.	Agriculture	209.15	0.46	206.92	0.45	-2.23	-1.06
3.	Barren/ unculturable/ Wasteland	35790.74	79.38	37580.57	83.30	1789.83	5.00
4.	Wetlands/Water bodies	744.26	1.65	863.76	1.91	119.5	16.05
5.	Snow and Glacier	8360.87	18.53	5257	11.65	-3103.87	-37.12
6.	Forest*	-	-	952.11	2.11	-	-
7.	Grass/Grazing*	-	-	237.78	0.52	-	-

Source: National Resources Census Project, NRSC

* The classification was added in 2011-12

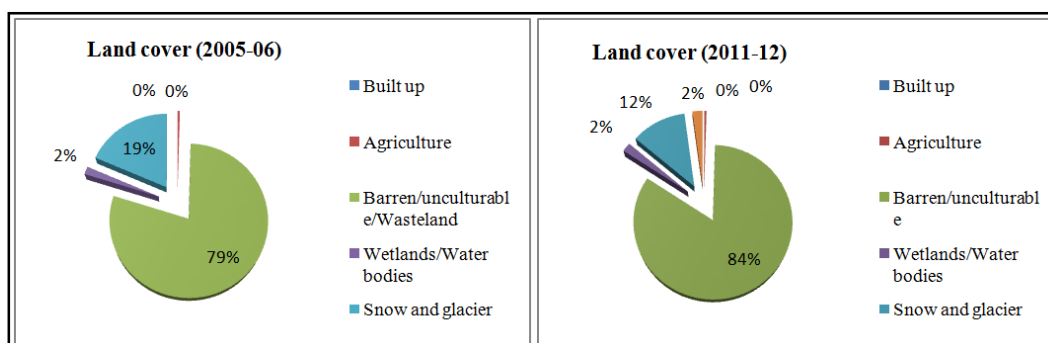


Figure 2: Land Cover and PGA, Leh District (2005-06 and 2011-12)

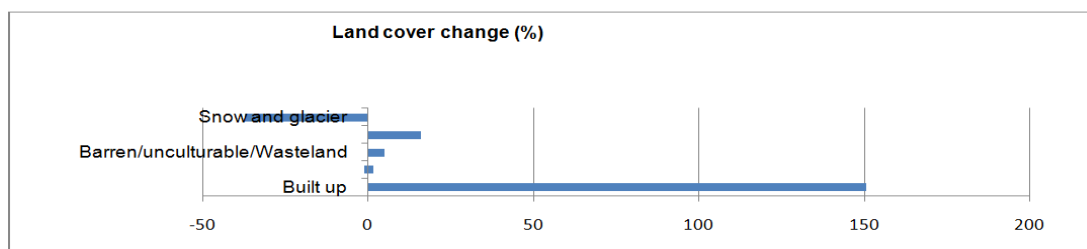


Figure 3: Temporal Change of Land Cover in Percentage (2005-06 and 2011-12)

The above graph represents the changes in Landcover for six years in Leh district. As there is no record related to Forest and Grass/Grazing in the previous year; therefore there is no computing of changes for them. The study if the graph suggests that on the one hand there is a significant increase in the share of Built up (150.63%); on the other hand Snow and Glacier (-37.12) land cover has endured maximum decline amongst all. Apart from these two land covers, there are others which have recorded positive change namely; Wetlands/Water bodies (16.05%) and Barren/ unculturable/wastelands (5%). Agriculture like Snow and Glacier has suffered a decline of 1.06% in the time frame of six years.

Land Use Classes

- Built-up Land**

The area of human habitation developed because of non-agricultural activities such as buildings, transport, communication and other utilities associated with water, vegetation and vacant lands comes under this land cover.

Table 2: Built-up Land Use (2005-06 and 2011-12)

S. No	Classes	2005-06	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Built up/ Urban	4.74	100	10.83	91.16	6.09	128.48
2.	Built up/ Rural*	-	-	1.05	8.84	-	-
3.	Built up	4.74	0.01	11.88	0.03	7.14	150.63

Source: National Resources Census Project, NRSC

*The classification was added in 2011-12

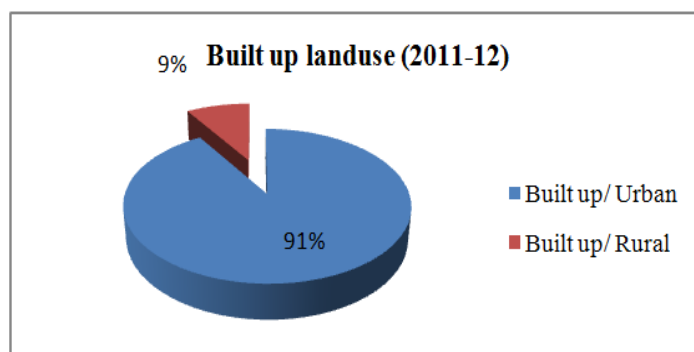


Figure 4: Built-up Land Use and PGA, Leh District (2005-06 and 2011-12)

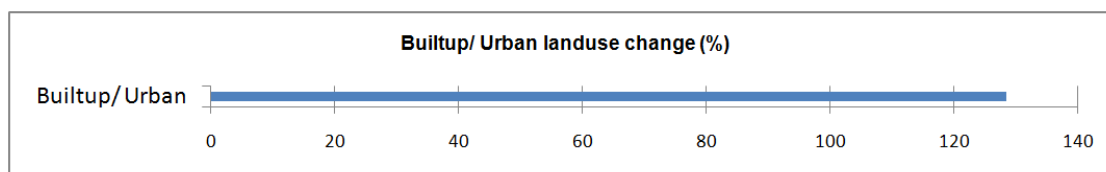


Figure 5: Temporal Change of Built-up Land Use (Urban) in Percentage (2005-06 and 2011-12)

PGA (Percentage to the total geographical area) for the year 2011-12 suggests that rural built-up contributes 8.84% to the total built-up land whereas urban built-up accounts for 91.16% of the total. There is a significant increase (128.48%) in built up land use during these six years (2005-2011). Since the rural built-up class is not evaluated during the first year, temporal change is calculated only for the urban built-up. The increase in urban built up can be reasoned with the increase in about 150% in the numbers of hotels and guest houses in the Leh town. Though the share of rural built up is negligible there is an ongoing trend of construction of residential houses with families getting nuclear and migration of the rural population to the town area.

- **Agriculture Land**

The land primarily used for farming and production of food, fodder and other commercial – horticulture crops comes under this land cover category. The agricultural land use type we have here are a plantation, cropland and fallow. Unlike the other two land use classes, fallow land was included in the evaluation only during the second time period (2011-12).

Table 3 Agriculture Land Use (2005-06 and 2011-12)

S. No	Classes	2005-05	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Agriculture/ Plantation	17.81	8.51	38.78	18.74	20.97	117.7
2.	Agriculture/ Cropland	191.34	91.48	168.05	81.21	-23.29	-12.2
3.	Agriculture/ Fallow*	-	-	0.09	0.04	-	-
4.	Agriculture	209.15	0.40	206.92	0.45	-2.23	-1.06

Source: National Resources Census Project, NRSC

*The classification was added in 2011-12

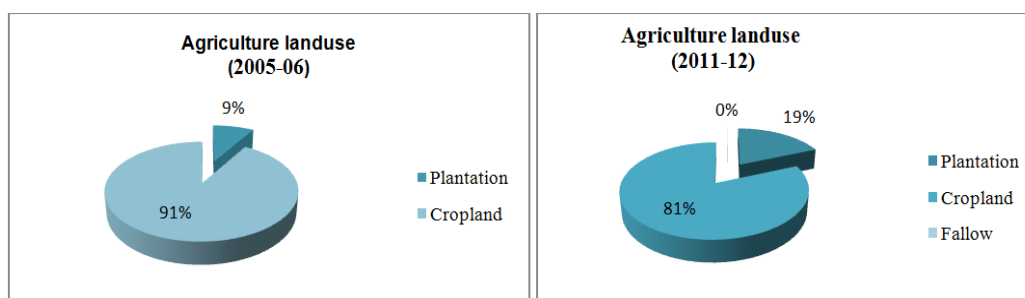


Figure 6: Agriculture Land Use and PGA, Leh District (2005-06 and 2011-12)

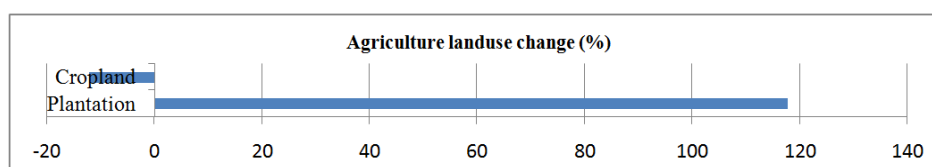


Figure 7: Temporal Change of Agricultural Land use in Percentage (2005-06 and 2011-12)

In both, the given time periods cropland leads the position in holding largest areal coverage (PGA of 91% in 2005-06 and 81% in 2011-12) but there is an overall decrease of -12.2% in its share during this six years. As far as plantation is concerned there is an increase of nearly 117.7% with regard to the base year of 2005-06. The decrease in the share of cropland can be linked with an increase in the plantation. As a matter of fact, there is a gradual shift in crop cultivation towards plantation, the reasons being easy to access to the market economy and government initiations like PDS (Public distribution system).

- **Wasteland**

These are often described as degraded lands which can be put to vegetation with sincere effort and which are at present underutilized which may lack appropriate water and soil management. It consists of land use classes such as salt-affected land, gullied/ ravenous land, scrubland, sandy area, barren rocky/ stony waste and rann area.

Table 4: Barren/ Unculturable/ Wasteland Land use (2005-06 and 2011-12)

S. No	Classes	2005-06	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Barren/ Unculturable/ Wasteland/ Gullied/Ravenous land	427.5	1.19	301.43	0.80	-126.07	-29.49
2.	Barren/ Unculturable/ Wasteland/ Salt affected land	73.33	0.24	60.74	0.16	-12.59	-17.16
3.	Barren/ Unculturable/ Wasteland/Sandy area	1794.6	5.01	1359.65	3.62	-434.95	-24.23
4.	Barren/ Unculturable/ Wasteland/ Scrubland	566.3	1.58	1398.21	3.72	831.91	146.90
5.	Barren/ Unculturable/ Wasteland/Barren rocky	32929.01	92.00	34460.54	91.69	1531.53	4.65
6.	Barren & Unculturable/wasteland	35790.74	79.34	37580.57	83.30	1789.83	5.00

Source: National Resources Census Project, NRSC

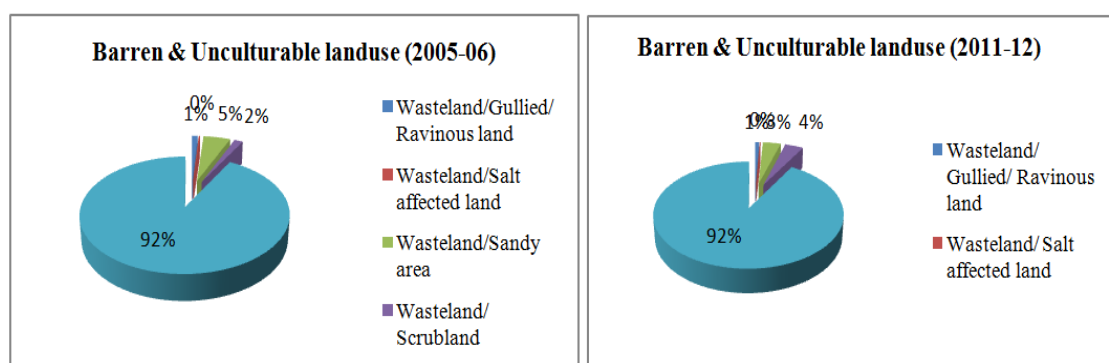


Figure 8: Barren/ Unculturable/ Wasteland Land use and PGA, Leh District (2005-06 and 2011-12)

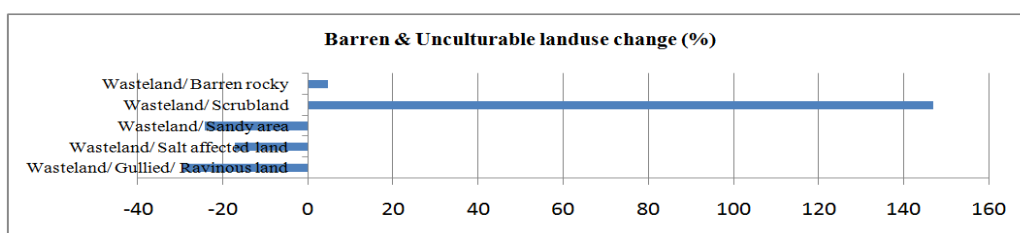


Figure 9: Temporal change of Barren/ Unculturable/ Wasteland Land use in Percentage (2005-06 and 2011-12)

The above graph shows both negative and positive temporal changes in the relative land use classes. The barren/ rocky class have the largest PGA in both the time periods (92% in 2005-06 and 91.69% in 2011-12). Three land use classes namely gullied/ ravenous land, salt affected and sandy area have lost shares of areal coverage to other classes. The maximum gain (146.90%) is under the class of scrubland while maximum loss is under gullied/ ravenous land (-29.49%). Ladakh is not an exception to the effect of recent phenomenon such as global warming. With the mercury rising, every

passing year witnesses uncertain but increase in rainfall, the ravenous valley regions are gradually being converting into the scrubland. Though for a short duration of time but the barren land supports life to scrubs and other commercially insignificant wild plants.

- **Wetland / Water Bodies**

Wetlands and water bodies consists of all submerged or water saturated lands, natural or manmade, inland or coastal, vegetated or non-vegetated, dynamic or static, which generally have land-water interface. The land cover includes classes such as rivers/ streams/ canals, reservoir/ lakes/ ponds and Inland wetland (this being included only in the second time period).

Table 5: Wetland/ Water Bodies Land use (2005-06 and 2011-12)

S. No	Classes	2005-06	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Wetlands/ Water bodies/ Rivers/ Streams/ Canals	185.18	24.88	318.12	36.82	132.94	71.28
2.	Wetlands/ Water bodies/Reservoir/ Lakes/ Ponds	559.08	75.11	359.6	41.63	-199.48	-35.68
3.	Wetlands/ Water bodies/ Inland Wetland*	-	-	186.04	21.53	-	-
4.	Wetlands & Water bodies	744.26	1.65	863.76	1.91	119.5	16.05

Source: National Resources Census Project, NRSC

*The classification was added in 2011-12.

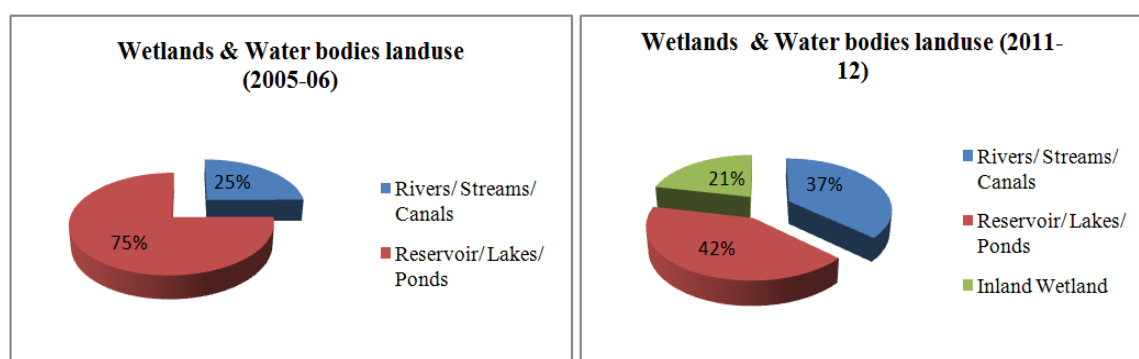


Figure 10: Wetland/ Water Bodies Land use and PGA, Leh District (2005-06 and 2011-12)

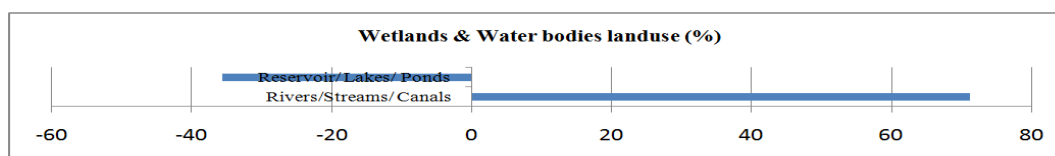


Figure 11: Temporal Change of Wetlands & Water Bodies Land use in Percentage (2005-06 and 2011-12)

The PGA of land use class; reservoir/ lakes/ ponds is largest of all the other classes during both the time period (75.11% in 2005-06 and 41.63% in 2011-12) but there is significant fall in the area coverage (-35.68%) under the same. Land use of rivers/ streams/ canals shows an increase of 71.28% area under it during reporting years. As glaciers of the world are receding, glaciers in Ladakh Himalaya except the Karakoram shows a same declining trend. The melting glacier obviously contributes to the glacier stream discharge which ultimately leads to the adding of river volume. The river volume in summer months is about thrice to that of the winters in Ladakh.

- **Snow and Glacier**

Glaciers are formed of the fallen snow which; over a period of years comprises into large thickened masses of ice. They are gradually formed when snow remains in one particular location for enough time to be transferred completely into ice.

Table 6: Snow and Glacier land use (2005-06 and 2011-12)

S. No	Classes	2005-06	PGA	2011-12	PGA	Absolute Change	Relative Change
1.	Snow and Glacier	8360.87	18.53	5257	11.65	-3103.87	-37.12

Source: National Resources Census Project, NRSC

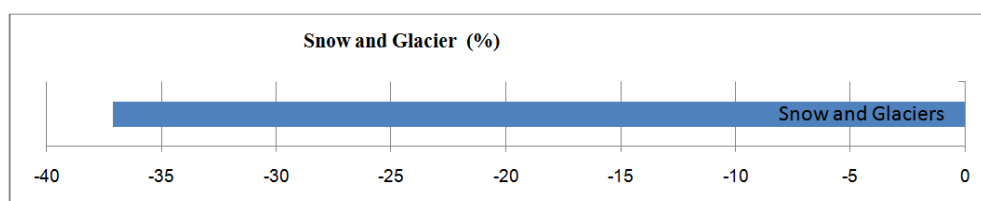


Figure 12: Temporal Change of Snow and Glacier land use in Percentage (2005-06 and 2011-12)

The above graph shows the change in the PGA of Snow and Glacier for the relative years of 2005-06 and 2011-12. As the table above shows that there are no land use classes other than the land cover itself; the analysis of the data reflect the significant decline (-37.12%) in the share of Snow and Glacier. There is a decline of 3103.87km² in the respective time period, which will ultimately have an important impact on the ecosystem as a whole.

CONCLUSIONS

The present study shows that the maximum number of land use classes (5 classes) that a land cover category have falls under Barren/ unculturable/ wasteland. These land use classes are; Gullied/ ravenous land, Salt-affected area, Sandy area, Scrubland, and Barren land. While the land cover category having the minimum classes (1 class) is Snow and Glacier. There were three such land use classes namely Rural land use under Built up, Fallow under Agriculture and Inland wetlands under Wetlands & water bodies which were added to the land cover in a later year; therefore changes regarding the mentioned classes was impossible to make. District Leh as a whole shows an increase of 128.48% in the share of the area under Built up/ urban and an increase of 117.7% in the share of area under agriculture/ plantation between the above mentioned period of 2005-06 and 2011-12. The land use category; Unculturable/ scrubland have the highest increase (146.90%) during the two time period. On the contrary, Snow and glacier reveal the major decrease (-37.12%) in its areal coverage. There is a decline of -35.68% in the area of land use classes such as Reservoirs/ lakes/ ponds and others like Gullied/ ravenous land (-29.49%). Land use classes such as Sandy area (-24.23%) has also recorded negative growth in its share during the same.

REFERENCES

1. Best, R. H., & Champion, A. G. (1970). Regional conversions of agricultural land to urban use in England and Wales, 1945-67. *Transactions of the Institute of British Geographers*, 15-32.
2. Bhupal, D. S. (2012). Changing land use pattern in India and its impact on supply of fresh Vegetables. *Journal of Agricultural Science and Technology*. A 2(8A), 952.
3. Blewett, R. A., & Lane, J. I. (1988). Development rights and the differential assessment of agricultural land: Fractional valuation of farmland is ineffective for preserving open space and subsidizes speculation. *American Journal of Economics and Sociology*, 47(2), 195-205.
4. Dadhich, P. N., & Hanaoka, S. (2011). Spatio-temporal urban growth modeling of Jaipur, India. *Journal of Urban Technology*, 18(3), 45-65.
5. Ratnaraju, C., Archana, N., Pramodreddy, A., Pranavi, S., Rakesh, A., & Uma, B. (2015). Modelling of infiltration rate of red soil under different land use conditions. *International Journal of Agricultural Science and Research (IJASR)*, 5(5), 305-312.
6. Drozd, D. J., & Johnson, B. B. (2004). Dynamics of a rural land market experiencing farmland conversion to acreages: the case of Saunders County, Nebraska. *Land Economics*, 80(2), 294-311.
7. Hui, E. C., & Bao, H. (2013). The logic behind conflicts in land acquisitions in contemporary China: A framework based upon game theory. *Land Use Policy*, 30(1), 373-380.
8. Kumar, V. (2012). SEZs land linked conflicts: In quest of amicable resolutions. *Indian Streams Research Journal*, 2(7): 1-15.
9. Turner, B. L., Meyer, W. B., & Skole, D. L. (1994). Global land-use/land-cover change: towards an integrated study. *Ambio*. Stockholm, 23(1), 91-95.
10. Latha, M., & Rajendran, M. Mapping and Monitoring Land Use/Land Cover Changes of An Ungauged Watershed Of Veeranam Tank, Cuddalore District, India.
11. Vitonset, D. M. et al. 1997. Human Domination of Health's Ecosystem. *Science*, 27, pp 494-499
12. Khan. J. H, Parveen. S, Ahmed. N. (2018). Regional Analysis of Sanitation Facilities in Uttar Pradesh. *Journal of Humanities and Social Sciences, (IOSR-JHSS)*, 20(10), pp. 48-56.
13. Xiaojuan, Lin, Min Xu, Chuxiang Cao, Singh, Wei Chen and Hongrui (Oct. 2018). Land- Use/ Land-Cover Changes and Their Influence on the Ecosystem in Chengdu City, China during the Period of 1992-2018. *Sustainability*. 10 (3580), pp 1-20. Doi:10.3390/su10103580

